Title: Whole Body Magnetic Resonance Angiography Using a 32 Channel MR Scanner: Initial Results

K. Nael[1], H. J. Michaely[1], M. Lee[1], S. G. Ruehm[1], G. Laub[2], J. P. Finn[1]

[1]Radiological Sciences, UCLA, Los Angeles, CA, United States, [2]Siemens Medical Solutions, Los Angeles, CA, United States

Background: MR angiography with extended coverage has been shown to have several clinical applications **(1,2)**. However, early implementations of whole-body MRA have used either a single-element body coil for reception or a device for sliding the patient through a stationary body array coil **(1)**, resulting in limited SNR and spatial resolution. With recent developments in multi-coil technology, it is now possible to distribute up to 76 coil elements over the body and to input the signal into 32 independent, quadrature receive channels. The challenge of whole-body MRA is now reduced to finding an optimal algorithm for multi-station acquisition which incorporates an appropriate contrast injection scheme, choice of sequence parameters, and table movement protocol.

Purpose: To evaluate a multi-station, whole body MR angiography protocol using a 32 channel MR system

Material and Methods: 5 adult healthy volunteers and 7 patients suspected of having peripheral vascular disease(PVD) (10 M, 2 F, 27-89 years old) were scanned with a 3D MRA sequence (TR/TE: 2.8/0.96ms; FA 25º; FOV 500 mm; slice thickness 1.5mm; 64-72 partitions; matrix 512x435; voxel size 1.1x1x1.5mm³; bandwidth 610Hz/pixel; GRAPPAx2) on a 32-channel 1.5 T MR system (Magnetom Avanto; Siemens Medical Solutions). Subjects were positioned supine on the scanner and 66 coil elements were activated in sequential stations, using up to 28 coils per station. The entire body was imaged using a two phase contrast injection scheme, two stations being acquired following each injection. Z coverage up to 1775 mm was accomplished in four overlapping stations, each with a 50 cm FOV, using a divided contrast injection scheme **(3)**. The z-displacement between adjacent stations was calculated as: Displacement z = (patient height – FOV)/3. Following an initial measurement of contrast transit time to the left heart and calves, a total dose of 50 ml gadodiamide (Omniscan, by Amersham Health Inc.) was infused in two separate doses at a rate of 1.5 ml/s followed by 30 ml of saline at a rate of 1.5 ml/s. Following the first injection, the most proximal station was acquired, followed by the most distal station. The intermediate two adjacent stations were acquired following the second contrast injection.

Subjects were instructed to hold their breath during acquisition of stations 1 and 2. Images from all 4 stations were scored on a 1-5 scale based on definition of vessel walls and overall image quality (not visible 1; visualized but inadequately 2; adequate for diagnosis 3; good 4, excellent 5). Venous contamination in each station was scored on a scale of 0-2 (none 0, mild not interfering with diagnosis 1, significant interfering with diagnosis 2). The presence of arterial disease was recorded and scored based on a scale of 1-3 (vessel irregularity 1, mild stenosis (<50%) 2, significant stenosis (>50%) 3). 33 arterial segments evaluated included: 1, 2: bilateral subclavians. 3,4: bilateral common carotids. 5,6 bilateral internal carotids . 7,8: bilateral vertebrals. 9: brachiocephalic trunk, 10: thoracic aorta, 11, 12: supra and infra renal aorta, 13: celiac 14: SMA, 15: IMA, 16,17: bilateral renal A. 18,19: bilateral common iliacs . 20,21: bilateral Ext iliacs. 22,23: bilateral femorals. 24,25: bilateral superficial femorals . 26,27: bilateral popliteals . 28,29: bilateral Anterior tibials. 30,31: bilateral Posterior tibials. 32,33: bilateral peroneals.

Results: All studies were technically successful. Our study identified all 33 segmental vessels in all subjects (100%) with mean visibility score> 4. Venous contamination was recorded as none or minimal in all four stations and never interfered with diagnostic evaluation. The result showed pathology in 84 arterial segments including 44 with irregularity, 10 segments with mild stenosis and 30 segments with high grade stenosis.

Conclusion:

Using a 32 channel RF system with multi-coil technology, whole body MRA is now feasible with spatial resolution sufficient for diagnosis in all vascular territories. Although more extensive clinical testing is warranted to explore the boundaries and limitations of the whole body approach, it seems likely that such an algorithm will replace those currently in use for lower extremity MRA.

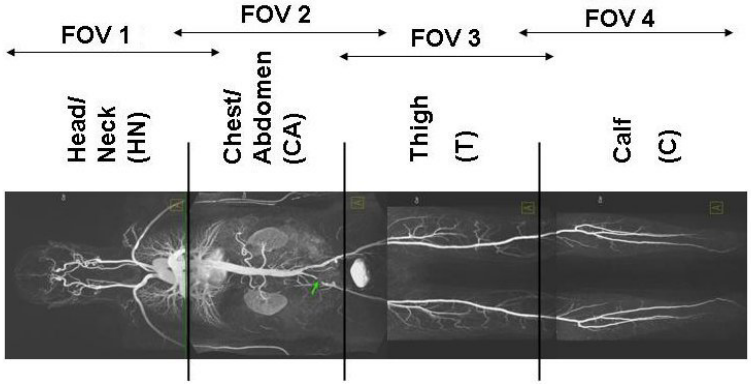

Figure-1. Shows the 4 stations imaging protocol and table movements. Subtracted MIP images in a subject suspected of having peripheral vascular disease, shows significant narrowing of right common iliac artery.

References:

1. Herborn C et al. 2004, AJR.
2. Goyen M et al. 2002, Radiology.
3. Morasch M et al. 2003, J Vasc Surg.